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Pacific Region
Canadian Science Advisory Secretariat
Science Advisory Report 2013/075

ADVICE RELEVANT TO THE IDENTIFICATION OF CRITICAL HABITAT FOR LEATHERBACK SEA TURTLES (PACIFIC POPULATION)

Leatherback Sea Turtle (DFO).

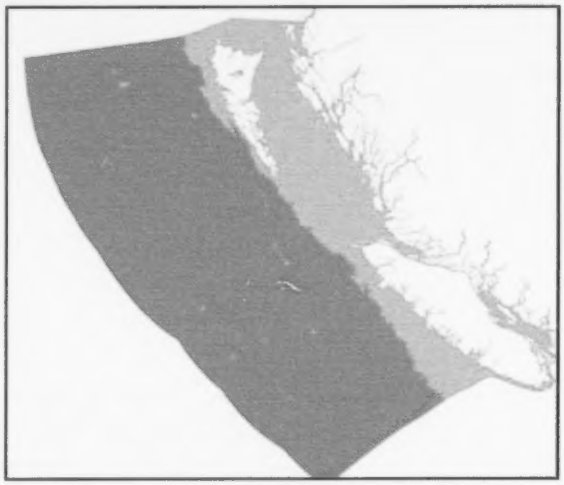

Figure 1. The Pacific Shelf to the toe of the continental slope (2000 m depth) is identified as important foraging habitat for Leatherback Sea Turtles.

Context:

The Leatherback Sea Turtle (Dermochelys coriacea) is a highly migratory reptile that occurs on both the Pacific and Atlantic coasts of Canada. In 1981, Leatherbacks were designated as Endangered by the Committee on the Status of Endangered Wildlife in Canada. This species became legally listed with the proclamation of the Species at Risk Act (SARA) in 2003. The Recovery Strategy for Leatherback Turtles in Pacific Canadian waters was published on the SARA registry in 2007. In 2012, the species was reassessed and two separate designatable units (populations) were identified, with both maintaining a designation of Endangered.

Advice was requested by Species At Risk program staff to review the best available information that would lead to recommendations for the identification of critical habitat for Leatherback Sea Turtles in Pacific Canadian waters.

This Science Advisory Report is from the December 5-6, 2012 Review of the model and information needed to identify Critical Habitat for Leatherback Turtle – Pacific Population. Additional publications from this meeting will be posted on the Fisheries and Oceans Canada (DFO) Science Advisory Schedule as they become available.

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Canada

SUMMARY

- In 1981, Leatherback Sea Turtle populations in Canadian waters were assessed by the Committee on the Status of Endangered Wildlife in Canada (COSEWIC) as Endangered.
- In 2003, the Leatherback Sea Turtle was listed as Endangered on Schedule 1 of the *Species at Risk Act* (*SARA*). In May 2012, the species was reassessed as two separate populations (Atlantic and Pacific). Both populations continue to be listed as Endangered.
- As part of the SARA recovery process, the "Recovery Strategy for the Leatherback Turtle populations in Pacific Canadian waters" was published on the *SARA* Registry in February 2007. Critical habitat was not identified at this time.
- Leatherback Sea Turtle sightings in British Columbia are infrequent. Data compiled from sightings, strandings and entanglements from 1931 to 2009 identified a total of 126 unique Leatherback sighting records from the waters of British Columbia.
- Leatherback Sea Turtles feed on scyphozoan prey in temperate high latitude locales, such as the Pacific Canadian coast.
- Using an envelope model to locate suitable habitat for Leatherback Sea Turtle foraging, the animal's known behavioural traits, and sightings information the spatial extent of possible critical habitat in Canadian Pacific waters was described.
- Future directions include improving the model predictive ability and exploring the robustness of the model. Validation of the model using the jellyfish survey database and detailed sightings data of foraging Leatherbacks was recommended.

INTRODUCTION

This document provides information for the identification of critical habitat for Leatherback Sea Turtles to the extent possible based on best available information. A key distinguishing characteristic of critical habitat (as defined by The Species at Risk Act or SARA) is that critical habitat is the component of habitat 'necessary' for survival or recovery of the species. The critical habitat identification process is an inherently iterative approach that is only complete when the recovery goal(s) is/are achieved.

The identification of critical habitat in the context of SARA must:

a) Specify the geospatial location of the Critical Habitat or describe the area within which Critical Habitat is found; and

b) Describe the known biophysical functions, features and attributes of that Critical Habitat that are required by the listed wildlife species in order to carry out life processes necessary for its survival or recovery.

A biophysical function is a characteristic of critical habitat that corresponds to a biological need or life-process requirement of the listed species. A function describes how the critical habitat is used by a listed species to support a life process and informs the rationale for its protection. This protection should in turn support the species recovery and survival.

The identification of critical habitat is legally required under SARA, and is defined as "the habitat necessary for recovery or survival of a listed wildlife species that is identified as the species' critical habitat in the recovery strategy or in an action plan for the species" (SARA s.2(1)). The stated goal of the Recovery Strategy is to ensure the "long-term viability of the leatherback turtle population(s) that frequent Pacific Canadian waters". At the time of Recovery Strategy preparation, there was insufficient information available to provide advice on the identification of critical habitat. Consequently, the recovery strategy contained a schedule of studies needed to obtain the information required for habitat identification.

When critical habitat is identified, examples of "activities likely to destroy critical habitat" should be provided. These activities must be of human origin. This serves to establish a baseline to identify and communicate to the Canadian public the kind of activities that are likely to lead to critical habitat destruction.

General Description

The Leatherback Sea Turtle is a highly migratory reptile that occurs on both the Pacific and Atlantic coasts of Canada. Unlike other marine turtles, keratinized scutes are absent from the Leatherback's carapace, and the front and rear flippers and head lack scales. Instead, the entire body is covered with a thin layer of skin, bluish-black on the dorsum and whitish-pink on the ventrum. In the Pacific, there are two principal nesting populations of Leatherbacks; one in the Eastern Pacific, including beaches in Mexico and Costa Rica; and one in the Western Pacific, including beaches in the Solomon Islands, Malaysia, Papua New Guinea, and Indonesia. A general long-term decline in the number of nesting females in the Pacific has contributed to the species' status as critically endangered (IUCN).

Nesting remigration intervals for Pacific Leatherbacks are considerably longer (by one or more years) than those of their Western Atlantic counterparts. This is believed to largely reflect the generally inferior and more variable Pacific Ocean foraging conditions, necessitating longer migrations between key foraging areas and nesting sites in order for turtles to acquire sufficient energy for reproduction. Seasonal exploitation of gelatinous plankton in temperate coastal foraging areas is a key characteristic of many Leatherback populations. This has been highlighted by telemetry studies, analysis of animal-borne video, and through documentation of body condition changes not only between nesting and temperate foraging areas, but also through the northern foraging period. Study of Leatherback foraging behaviour in temperate waters off Atlantic Canada reveals inter-annual fidelity to foraging areas, and acquisition of energy far in excess of metabolic requirements. Areas characterized by high jellyfish biomass are critical for sustaining energy requirements of this fast-growing species, and high-latitude coastal areas used by Leatherbacks in the Atlantic and Pacific coast of Canada provide foraging opportunities important not only to the survival and reproduction of individual turtles, but also to the recovery of associated nesting populations.

Jellyfish are very easy to capture, as they have a negligible escape response, especially from an animal as fast and manoeuvrable as a sea turtle. In addition, jellyfish are relatively easy to digest, and many types of jellies occur in dense aggregations known as blooms, due to their unique life histories and behaviours. This gelatinous diet appears to provide all of the Leatherback's energetic demands, as well as allowing them to add mass for return migrations to breeding and nesting habitats. Therefore, locating dense blooms of jellyfish in coastal waters may be a key factor in Leatherback foraging success. Understanding the association between Leatherbacks and their gelatinous prey is central to identifying critical habitat.

ANALYSIS

Approach to Identifying Critical Habitat

The recommendations set forth in DFO's "Operational Guidelines for the Identification of Critical Habitat" (Fisheries and Oceans Canada 2012) detail a number of methods used to define the habitat necessary to support the population and distribution objectives for a species. With many species, identification of habitat begins with the repeated observation of individuals associated with a geospatial location, and an *area of occurrence* approach is undertaken. Based on the logical assumption that a high recurrence of individuals in an area indicates that the habitat is suitable, and possibly necessary for survival, the *area of occurrence* approach is often the starting point for critical habitat investigations and assists in the development of the schedule of studies. Once the geospatial area has been defined, the function served by the habitat may be established and the features that support the identified function may also be identified. The *area of occurrence* approach assumes that the functions and features necessary for the species' survival or recovery exist within the defined geospatial boundary. In the case of data deficient species, or those with an infrequent presence in Canada, this method is problematic and the issue must be approached from another direction. A second method, the *bounding box* approach, is utilized when there is sufficient knowledge of the function that the habitat serves for the species, and the supporting features are present and describable. Although this approach is often supplemented by sightings or survey data, it is not dependent on the presence of individuals, but instead relies on the identification of functions and features that support the survival or recovery of the species.

Satellite tagging data of Leatherback Sea Turtles from both the Atlantic and Pacific populations indicate that temperate waters serve as foraging grounds, and the primary prey species is known to be gelatinous zooplankton. Furthermore, given the low energy density of jellyfish, Leatherbacks must consume proportionately larger quantities that would be required for other prey. As such, locating dense concentrations of jellyfish is central to Leatherback foraging success, and may be an important determining factor for the health of a population. The selection of applicable criteria to support the envelope model involved a thorough review of the literature on oceanographic features and conditions associated with Leatherback foraging, as well as factors that support the presence and entrainment of scyphomedusae.

The factors selected for the habitat model are those oceanographic features that are presumed to support the presence of jellyfish, thereby providing sufficient prey concentrations for foraging Leatherback Sea Turtles. Locations of entrainment of prey items, which occur with a higher than average frequency, are likely important to the delineation of potential foraging areas. The importance of these areas may be reinforced by the associated, elevated levels of primary production which would be expected to support more abundant zooplankton communities, suitable for jellyfish foraging. Given the need to maximise independence among the variables, the Recovery Team assumed that high Chlorophyll a (Chla) levels was a sufficient proxy for both primary production and concentration features.

The suggestion that Leatherback Sea Turtles forage in low energy areas led the Recovery Team to consider current energy as the second independent variable for the envelope model. Root Mean Square (RMS) current velocity was modeled.

The resulting suitable habitat prediction (Figure 2), obtained after pooling the Chla*RMS prediction into three classes, is dominated by a large area off Vancouver Island, where high

Chla and low RMS occurred predictably during the months considered. Smaller areas in the Strait of Georgia and on the North Coast capture the regions of predictably high Chla due to fresh water input in these two regions. Other smaller areas of potential Leatherback habitat include the areas around Calvert Island and the Goose Group, both on the Central Coast and areas of known ecological importance. A third area east of Skidigate Inlet is also identified as an area of potential Leatherback habitat.

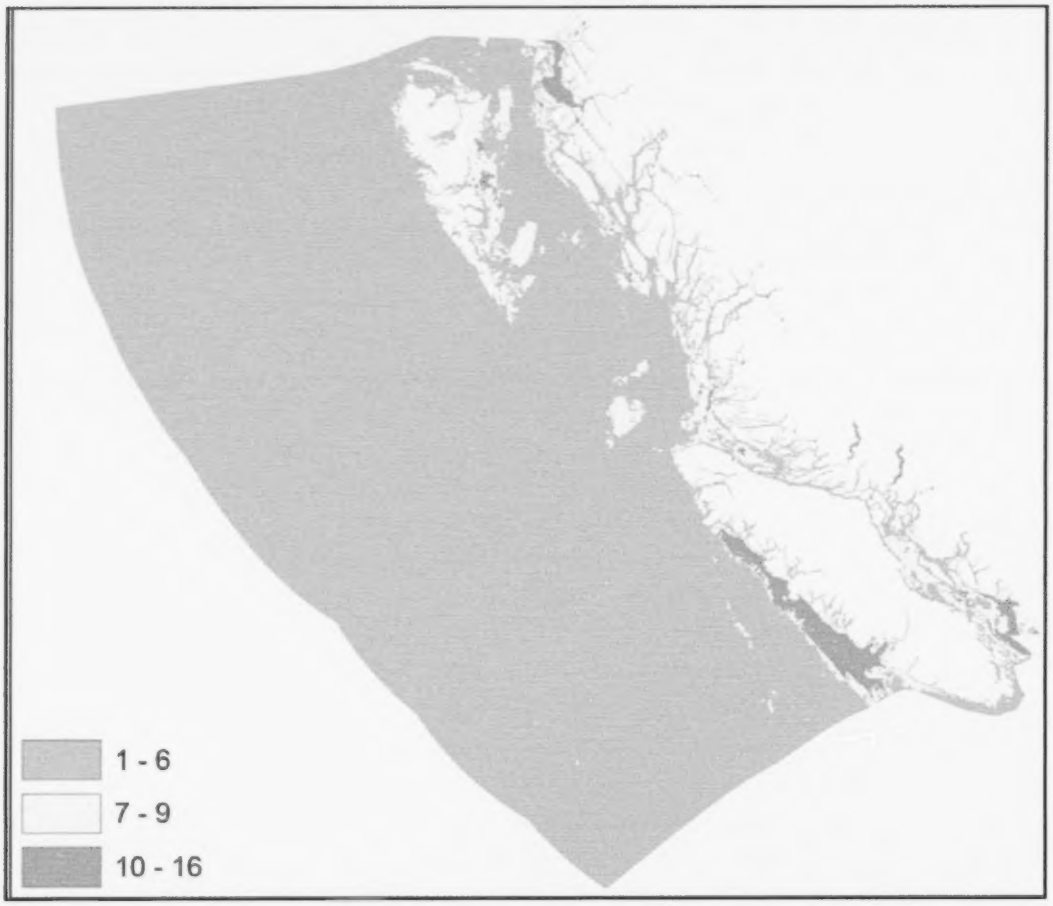

Figure 2. Modeled areas of suitable foraging habitat for Leatherback Sea Turtles shown as low (green), medium (yellow) and high (red) suitability.)

Leatherback Sea Turtle sightings in British Columbia are infrequent. Data compiled from sightings, strandings and entanglements from 1931 to 2009 identified a total of 122 unique Leatherback live sighting records from the waters of British Columbia (Figure 3). These data represent a compilation of information collected through surveys, questionnaires, entanglement records, strandings, and observations obtained during ship-based cetacean surveys. As the majority of these sightings were opportunistic and therefore biased with respect to effort, it is difficult to draw conclusions as to the distribution and habitat use of Leatherbacks in Pacific Canadian waters. However, it is the only empirical information that is currently available on Leatherback presence in Canadian Pacific waters.

Finally, the review team considered the importance of depth, since several lines of evidence suggest that Leatherback Sea Turtles may preferentially forage in on-shelf areas in Pacific Canada. Research on Atlantic Leatherbacks supports the concept of shelf importance to foraging, as aerial transects demonstrate significantly higher density of turtles on the shelf during the foraging season. In addition, sampling on Atlantic turtles found that foraging behaviour was seldom exhibited in deep water areas off the shelf.

With three different lines of evidence (modeled preferred habitat, empirical observations and known turtle behaviour) supporting the recommendation, critical habitat for the Leatherback Sea Turtle in Canadian Pacific waters was recommended to encompass the majority of the continental shelf (Figure 1) to a depth of 2000 m, excluding the mainland inlets and portions of the Strait of Georgia.

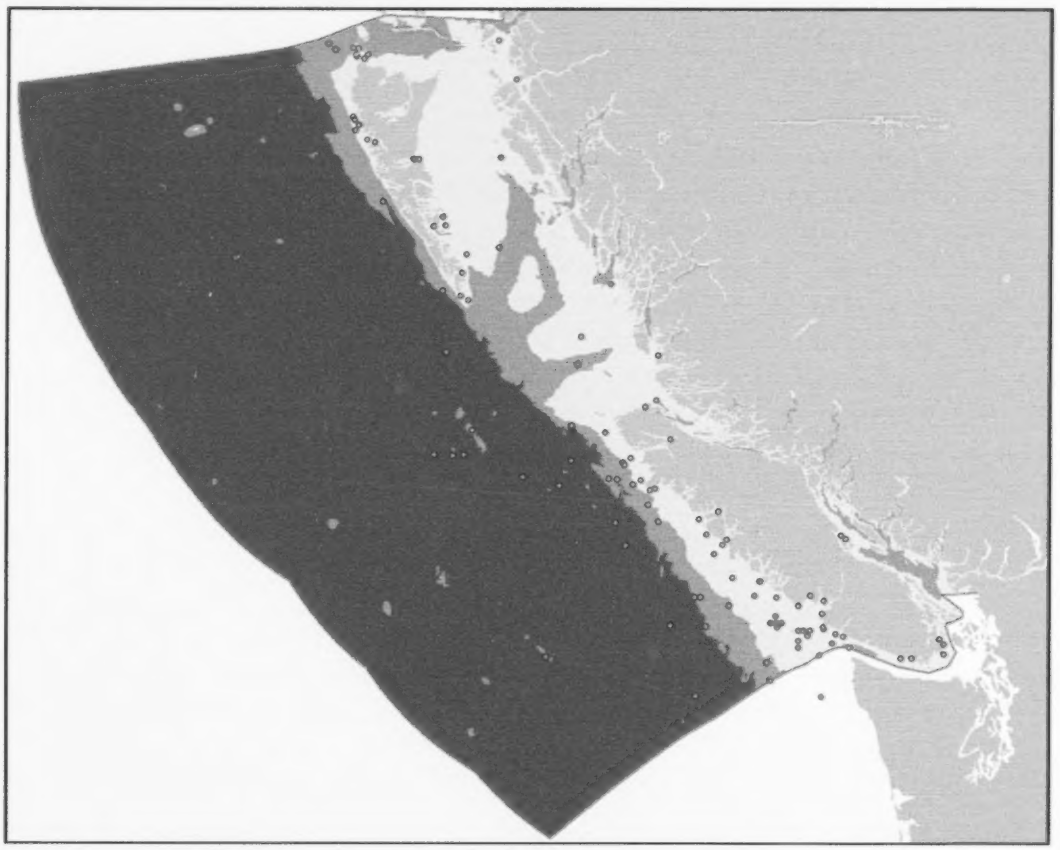

Figure 2. Live Leatherback Sea Turtle sightings (n=122) in the Canadian Pacific exclusive economic zone. The depth categories are continental shelf to 200 m (light blue); 1500 m (moderate blue); and offshore waters (dark blue).

Ecosystem consideration

The recommendation for critical habitat for the Leatherback Sea Turtle may ultimately benefit not only turtles but other species as well. The identification of critical habitat for the Leatherback Sea Turtle and its role in the ecosystem will raise awareness and consideration of

the important role that Pacific Canadian waters play in the species recovery. As the model predicts foraging areas based on entrainment and the presence of phytoplankton, it could be adapted for use in modeling habitat for other planktivores.

Sources of Uncertainties

- Effect of tidal currents on the model was not considered.
- Importance of sea surface temperature (SST) on Leatherback Sea Turtle behaviour.
- Canadian habitat may be at the northern extent of their range and sightings are infrequent.
- Leatherback Sea Turtle observation effort is low.
- Prey composition in Pacific Canadian waters is not known.
- General paucity of data on the density and distribution of scyphomedusae in Canadian Pacific waters.
- Model has not been validated with observations of jellyfish in Canadian Pacific waters.
- Modeled areas of foraging habitat suitability have not been validated by the presence of Leatherback Sea Turtles.
- The analysis and construction of the mechanistic model is based on observations and data collection from outside Canadian Pacific waters.
- Uncertainty of linear relationship between variables of chlorophyll and RMS and the association to the concentrations of jellyfish.
- The temporal aspect of the data upon which the model was based may not hold true in the future; e.g., the occurrence of El Nino / La Nina events.

CONCLUSIONS AND ADVICE

Three lines of evidence support the recommendation that critical habitat for Leatherback Sea Turtles should consist of the entire shelf (Figure 1), excluding the mainland inlets, river deltas and portions of the Strait of Georgia (based on modeled area of high forage suitability, observations, and turtle behaviour). The shelf is defined as being from the toe of the slope (2000m) shoreward excluding areas of low salinity or freshwater outflow.

The following considerations for refining and delineating the proposed boundaries are recommended.

- Verification of the species and density of jellyfish in modeled areas;
- Identification of locations of Leatherback Sea Turtles in Canadian waters;
- Investigation of the relationship with foraging and transiting turtles and SST;
- Development of a schedule of studies to refine the boundaries of critical habitat over time as more information becomes available; and,
- Investigation of the uncertainty of exclusion of nearshore waters as potential critical habitat.

SOURCES OF INFORMATION

This Science Advisory Report is from the December 5-6, 2012 Review of the model and information needed to identify Critical Habitat for Leatherback Turtle – Pacific Population. Additional publications from this meeting will be posted on the Fisheries and Oceans Canada (DFO) Science Advisory Schedule as they become available.

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